high as with the usual method of combining the ball electrode with punctures. Since the number of cases thus treated is still too small for statistical study, no figures can be given at this time. The details of the operation will be published in the near future.

The principle of the treatment is not to occlude the tear, but first to produce a plastic reaction of the choroid in the region corresponding to and surrounding the tear; and, secondly, to remove some fluid behind the retina so as to make it possible for the retina to come in apposition with the choroid and remain so for a number of weeks.

Before closing, it might be well generally to outline the causes of failures. They are:

(1) Faulty localization of the tear.
(2) Failure to appreciate the importance of discovering the tear.
(3) Lack of understanding of the condition of the eye.
(4) Lack of precise methods of measuring and controlling the effectivity of the current at any moment during the operation.

Summary

An attempt was made to trace the natural evolution of the concept of the methods of treatment of retinal detachment. The tendency at present is to simplify both the method and the apparatus. The author's procedure is described.

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DETACHMENT OF THE RETINA

Evolution of Its Modern Management *

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The last few years have brought no fundamental changes in the surgery of this condition. The diathermic method, in one form or another, or in combination with other methods, has found universal acceptance as the standard treatment. The finer details of the technic are still in the process of evolution, and the tendency at present is toward its simplification. In reviewing the history of the treatment of retinal detachment, one is impressed by the almost exclusive role physical therapy has played in this epoch-making advance in ophthalmology.

The purpose of this paper is to facilitate the understanding of the modern methods of treatment by presenting them in the light of their historical development. It is particularly interesting to observe in this connection how the evolution of the theoretic concept regarding the etiology and pathogenesis progressed parallel with the development of methods and apparatus employed in treating retinal detachments.

Methods of Management

The methods which have been employed may be classified as: (1) Thermocauterization; (2) chemical cauterization; (3) diathermy (surface and puncture); (4) electrolysis, and (5) the use of the thermophore.

Thermocauterization. — To Gonin belongs the unique distinction of having recognized that the tear is the cause of detachment and that it is necessary to close the defect in order to bring about a cure. He advanced this theory in 1919,[1] but it took ten years before it began to find acceptance among his colleagues. Gonin's method[2] as is well known, consists in introducing the tip of a thermocautery through an incision of the sclera and searing the edges of the retinal tear.

Attempts to treat retinal detachment had been made long ago, even before the condition could be diagnosed clinically. Some of these attempts had followed the right direction, but were not carried far enough. The same physical agents were used then as now, but were soon discarded because they failed to bring about the desired result.

I shall mention but a few instances from the early history of the operative treatment of detachment. James Ware, in 1805, or 45 years before the ophthalmoscope was invented, attempted to cure a case of suspected detachment by puncturing the eyeball. De Wecker, in 1881, used the galvanocautery, but he did not direct the treatment at the tear. Schoeler, in 1889, was the first to treat the retinal tear but did not meet with success. He tried to produce chemical cauterization by injection of tincture of iodine. In 1893, Schoeler also began to use electrolysis (anode). Galezowski, in 1902, was the first to treat the area of the retinal tear directly with the galvanocautery and to report good results with this method.[3]

The one drawback of the Gonin method of operation was the necessity of extremely accurate localization of the tear. To obviate this, other procedures were being developed, all having the same objective; namely, to wall off the tear from the rest of the retina by producing a zone of adhesive chorio-retinitis around the tear.

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Chemical Cauterization. — Guist, in 1931, devised a method of chemical cauterization. Several scleral trephinings are made in the zone surrounding the tear, then the exposed choroid is treated with sodium hydroxide. This method was time-consuming and sometimes led to severe reactions.

Diathermy. — The first to apply the diathermic current to the treatment of retinal detachment was Larsson,[4] in 1930. He used a ball electrode to surround the region of the tear with surface coagulations.

About the same time, Weve[5] began to use diathermy. At first he employed the surface method, but later he developed the puncture technic, using long needle electrodes.

The next step was taken by Safar,[6] who introduced the multiple puncture technic. He applied needle-studded plates, looking like little brushes, and left them in the sclera until the end of the operation, so as to prevent the premature escape of vitreous. He also used brush-like electrodes mounted on handles.

Clifford Walker[7] followed up Safar's idea by devising small, single point electrodes which he called "micropins." They are not insulated at the base as Safar's electrodes are. They may be threaded to prevent loss of any pins.

Schoenberg[8] in 1935, described a new double hook electrode which we have been using during the past five years to the exclusion of all other perforating electrodes. At first, we used also a small ball electrode, but lately we have given it up.

This double hook is made of steel or of platinum-iridium and is not insulated. The points are so bent that they penetrate the sclera obliquely, thus giving a more gradual loss of subretinal fluid. The electrode may also be used effectively to puncture the sclera without perforating it, as will be pointed out later. The electrode serves also as a retractor when the area to be treated is situated far back. The chief advantages of this instrument are its versatility and its slender shape.

Since the effect of the diathermic current is dependent on the degree of heat generated within the tissues, this cannot be exactly measured by means of the milliammeter.

Coppez[9] devised a pyrometric electrode which uses the principle of the thermocouple and which thus measures directly the temperature of the tissues treated. The electrode or warm couple consists of a constantan and a copper wire soldered together. The other, the cold couple, is immersed in ice water. A galvanometer is calibrated in degrees centigrade and records the temperature generated in the tissues. If a temperature of 80 C. is reached in 30 seconds, the optimum amount of coagulation results. Only flat electrodes can be used with the pyrometric method, so that it is not applicable to the various puncture technics.

Electrolysis. — The destructive effect of electrolysis on tissues has also been utilized. Electrolysis acts partly by heating the tissues and partly by the chemical caustic action of the ions liberated.

Vogt[10] in 1934, introduced catholysis, i. e., the cathode as the active electrode. This is a delicate needle to make punctures, while the anode in the form of a metal ball is held against the eyeball by an assistant. One-half to one milliampere is applied for one second. The gas bubbles liberated in the eyeball are useful in localizing the tear and as a general means of orientation. Walker[11] has adopted this method with some modification, usually employing it in conjunction with diathermy.

Von Szily and Machemer[12] also developed an electrolytic technic, but they use a bipolar electrode. Both poles end in sharp points close together and are held in contact with the sclera, thus giving a strictly localized surface effect. For punctures, the anode is used; while the cathode, being shorter and blunt, makes contact with the surface of the sclera. Thus, their method differs from the catholysis of Vogt; no gas bubbles are liberated at the anode if a steel needle is applied. They introduce greater amounts of current and longer applications than Vogt.

The chief advantage of the electrolytic method is the lower cost and easier portability of the apparatus. However, the resulting scars are very delicate, so that in the average case either diathermy or a combination of diathermy and electrolysis should be employed.

Thermophore. — A simple way of applying heat to the eyeball is by the Shahan thermophore. This is a metal applicator which is heated electrically and is equipped with a thermostatic control. Temperatures between 155 and 165 F. give the best surface coagulations. The first case treated successfully with this method was reported by H. Maxwell Langdon,[13] in 1935.

Author's Method

Schoenberg, who has followed the evolution of retinal detachment surgery since its incipiency,[14-15-16] has developed a simple and effective technic for the diathermic treatment of retinal detachment. Being associated with him, I have adopted and found it to be very dependable and practical.

The chief virtue of the method lies in the fact that it uses only one type of electrode. When the surgeon is familiar with his tools, he can concern himself more directly with the physiology and pathology of the condition he is treating; his mind is not hampered by a maze of technical problems.

I need not describe the operation in detail, since this has already been done by Schoenberg in previous communications.[17-18] Besides, the general principles of surgery were outlined in a masterly fashion by Nugent[19] and Peter,[20] in 1936. I shall merely point out the main features of our technic.

The electrode, as mentioned above, is a double hook with its points so bent that it does not perforate the sclera perpendicularly, but passes obliquely through it. It also serves as a retractor for reaching deeply situated regions of the eyeball.

The shank is left uninsulated. A thin insulation does not offer adequate protection, and a thick insulation renders the instrument too clumsy to handle. By applying the current only after the electrode is in position, with the shank free and the tips touching the eyeball, no mishaps need be feared.

The generator is made by Liebel-Flarsheim and is equipped with both a coagulating current and a special retinal detachment current which has also some cutting qualities. For perforating punctures the latter current is used.

In the past we preceded the punctures by surface diathermy with a small ball electrode, of 3 mm. diameter and the coagulating current. But lately, in order to avoid too extensive an atrophy of the choroid, we have dispensed with the ball electrode, relying almost entirely on the double hook electrode.

At first, the coagulating current is used and the hook electrode is introduced very obliquely into the sclera, but not through it. This results actually in small, circumscribed areas of surface coagulation. During this part of the operation no fluid is lost, in fact, the eyeball usually gets hard. If the tension becomes unduly high, fluid will ooze out through some of the coagulated areas.

After the entire area has been thus treated, a few through and through punctures are made with the same electrode, with the retinal detachment current (which possesses also cutting qualities), in order to allow for the escape of subretinal fluid.

The cases treated by this method have given excellent functional results; namely, very little postoperative reaction; small, discrete coagulation areas about ¼ disk diameter in size, and no loss of field corresponding to the treated area. The percentage of successful results seems to be at least as